DESIGN AND DEVELOPMENT OF LOW-COST FRICTION STIR WELDING

AHMAD SYAZNI BIN ZAKARIA

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To my beloved father **Dr. Zakaria Bin Haji Kassim**

To my beloved mother **Sharifah Binti Haji Idris**

To my beloved sisters **Datin Shazelina Binti Zakaria** and **Haslinda Binti Zakaria**

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In the name of Allah, the most Gracious and most Compassionate

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ABSTRACT

The purpose of this study is to design and develop a friction stir welding (FSW) based on current CNC machine. The development is based on CNC milling machine using FSW tool that been machined. Aluminium Alloy 5083 was used as workpiece sample while mild steel was selected as the material for the tool. The experiments are based on selected welding conditions such as feed speed, tool rotation speed, plunge depth and tool design. Some of the parameter was set to a certain value, thus leaving 3 parameters with different value. For analyzation, feed speed and tool rotation was concentrated to study which parameter is the best based on analysis, either the combination of 10, 15 and 20 mm/min feed speed and tool rotation of 1000, 1500 and 2000 rpm. Post analysis involving hardness test, impact test and microstructure analysis. The experimental results were statistically analyzed to study the influence of both parameters on weld area cross section. Based on hardness test and impact test, the weld area are strong enough after combining two aluminum. The microstructural imaging shows that at certain number of feed speed or rotation speed, the weld area starting to crack. The outcome of this study shows that feed speed and tool rotation speed have significance effects on the strength and cosmetic of weld area and the best condition is at 10 mm/min feed speed and 1000 rpm of tool rotation speed. The results also shows that the setting of the experiment can have bigger effect on the welding result.

ABSTRAK

Tujuan kertas penyelidikan ini dijalankan adalah untuk merekabentuk dan membangunkan kimpalan geseran kacau (FSW) berdasarkan pada mesin CNC yang terkini. Pembangunan ini adalah berdasarkan pada mesin "*milling*" CNC menggunakan alat FSW yang telah dimesin. Aluminium Alloy 5083 telah digunakan sebagai sampel bahan kerja manakala "*mild* steel" telah dipilih sebagai bahan untuk alat. Eksperimen berdasarkan keadaan kimpalan terpilih seperti kelajuan halaan, alat kelajuan putaran, kedalaman tolakan bawah dan reka bentuk alat. Ada di antara parameter yang telah ditetapkan kepada nilai tertentu, sekali gus meninggalkan 3 parameter dengan nilai yang berbeza. Untuk analisis, kelajuan halaan dan putaran alat adalah tertumpu untuk mengkaji parameter yang terbaik berdasarkan analisis, sama ada gabungan 10, 15 dan 20 mm / min kelajuan halaan dan putaran alat 1000, 1500 dan 2000 rpm. Analisis selepas eksperimen melibatkan ujian kekerasan, ujian hentaman dan analisis mikrostruktur. Keputusan eksperimen telah dianalisis secara statistik untuk mengkaji pengaruh kedua-dua parameter pada keratan rentas kawasan kimpalan. Berdasarkan ujian kekerasan dan ujian kesan, kawasan kimpalan cukup kuat selepas menggabungkan dua aluminium. Pengimejan mikrostruktur menunjukkan bahawa pada sebilangan kelajuan suapan atau kelajuan putaran, kawasan kimpalan mula retak. Hasil kajian ini menunjukkan bahawa kelajuan halaan dan alat kelajuan putaran mempunyai kesan signifikan kepada kekuatan dan kosmetik kawasan kimpalan dan keadaan yang terbaik adalah pada 10 mm / min kelajuan halaan dan 1000 rpm kelajuan putaran alat. Keputusan juga menunjukkan bahawa penetapan eksperimen boleh mempunyai kesan yang lebih besar ke atas hasil kimpalan.